

## **Appendix G**

### **Impact of Lateral Placement on Different Lateral Support Conditions**

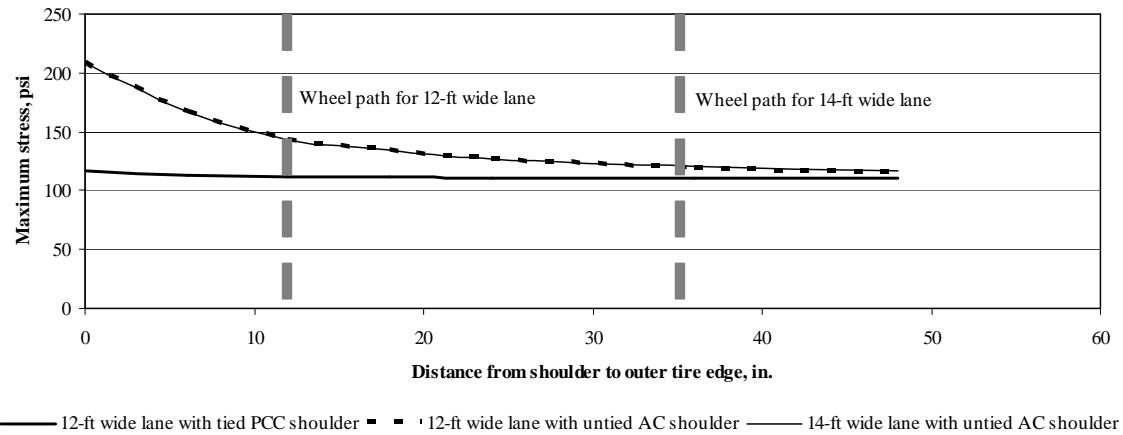
**Table G-1: Experimental matrix for lateral placement study**

Stress type	$\alpha(\Delta T/D)$ , $10^6 \text{ in.}^{-1}$	177-in. joint spacing			315-in. joint spacing		
		12-ft wide lane with tied PCC shoulder	12-ft wide lane with untied AC shoulder	14-ft wide lane with untied AC shoulder	12-ft wide lane with tied PCC shoulder	12-ft wide lane with untied AC shoulder	14-ft wide lane with untied AC shoulder
Longitudinal stress at the bottom of the PCC slab	0	✓	✓	✓	✓	✓	✓
	10	✓	✓	✓	✓	✓	✓
	20	✓	✓	✓	✓	✓	✓
Longitudinal stress at the top of the PCC slab	0	✓	✓	✓	✓	✓	✓
	-10	✓	✓	✓	✓	✓	✓
	-20	✓	✓	✓	✓	✓	✓

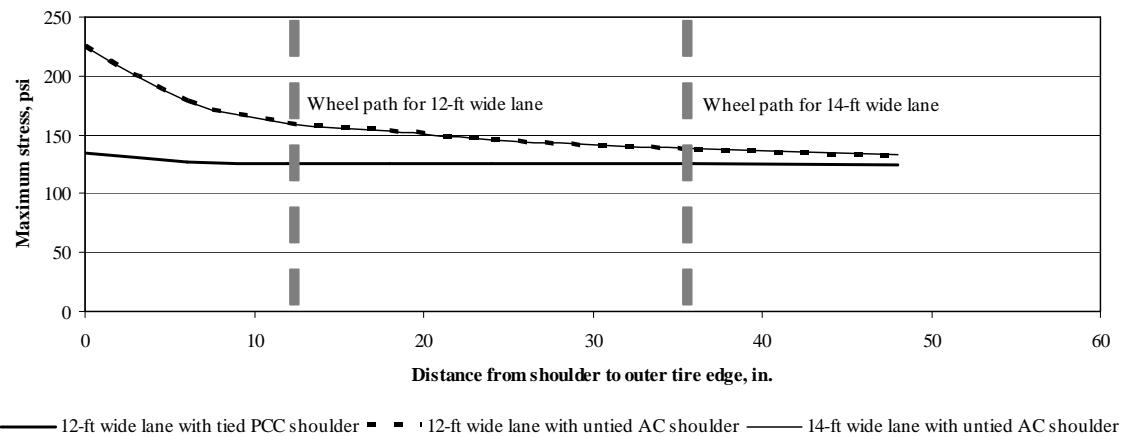
Remarks:

- 1) Each condition contains seven lateral placements: 0, 6, 12, 18, 24, 36, and 48 in.
- 2) Each condition contains three types of axles: single, tandem, and tridem.
- 3) Load positions are edge and corner loading conditions for analysis of stress at the bottom and the top of the PCC slab, respectively.
- 4) All the analyses are conducted for 10-in. PCC slab, 16-in. base/subbase, 100-psi/in. subgrade.

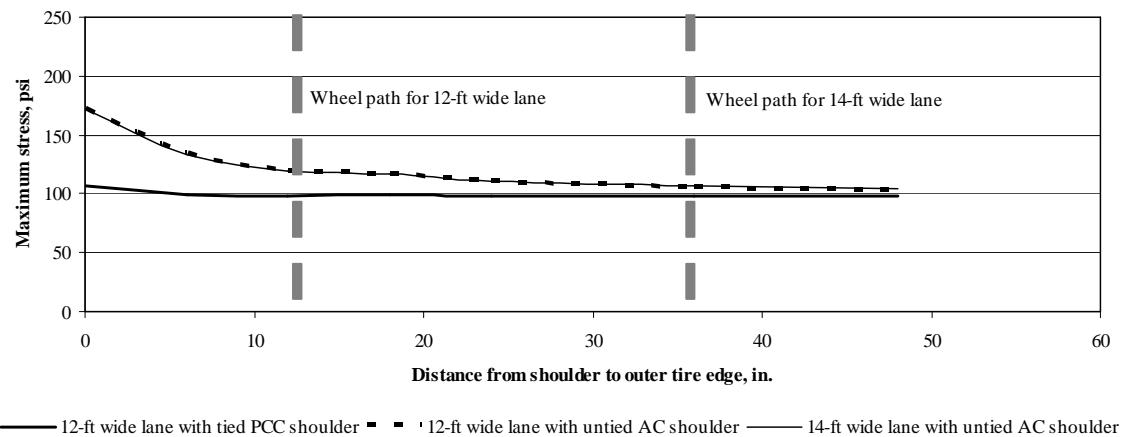
Figures G-1 through G-3 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $0 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-1: Illustration for single axle**

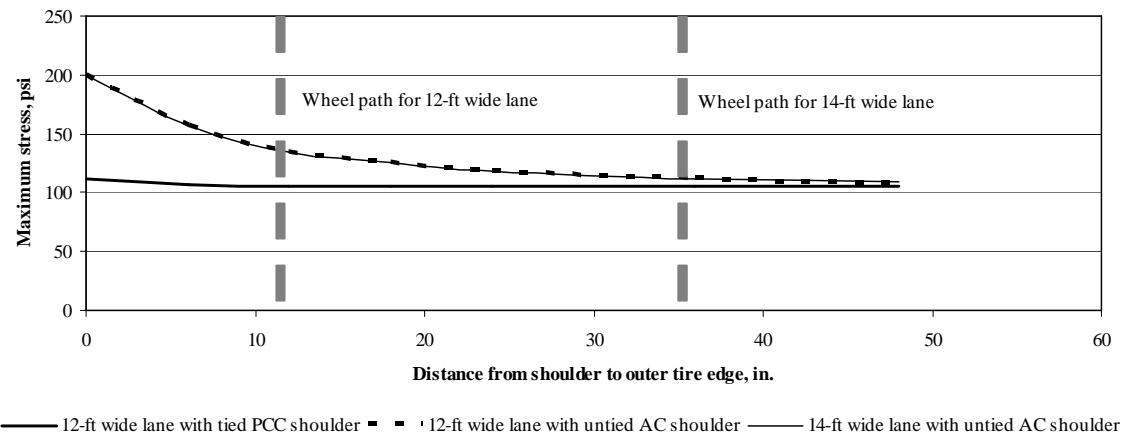


**Figure G-2: Illustration for tandem axle**

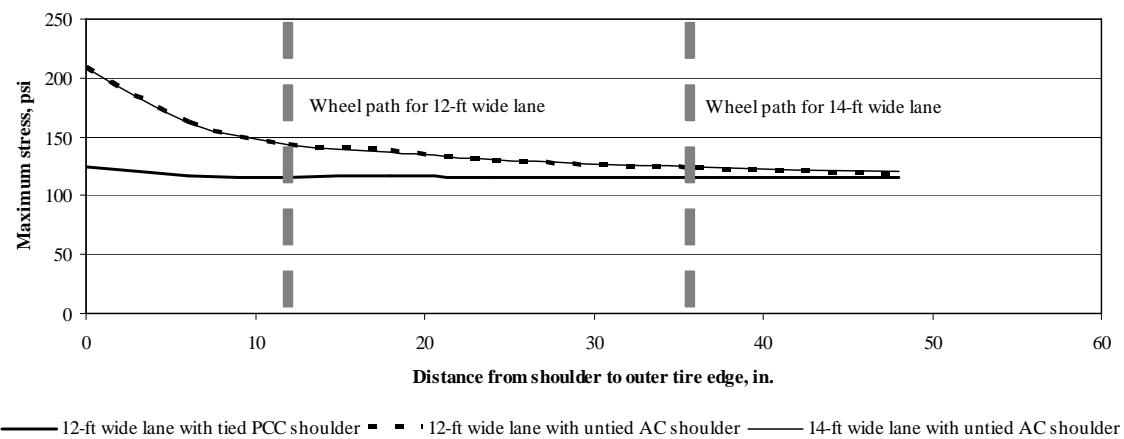


**Figure G-3: Illustration for tridem axle**

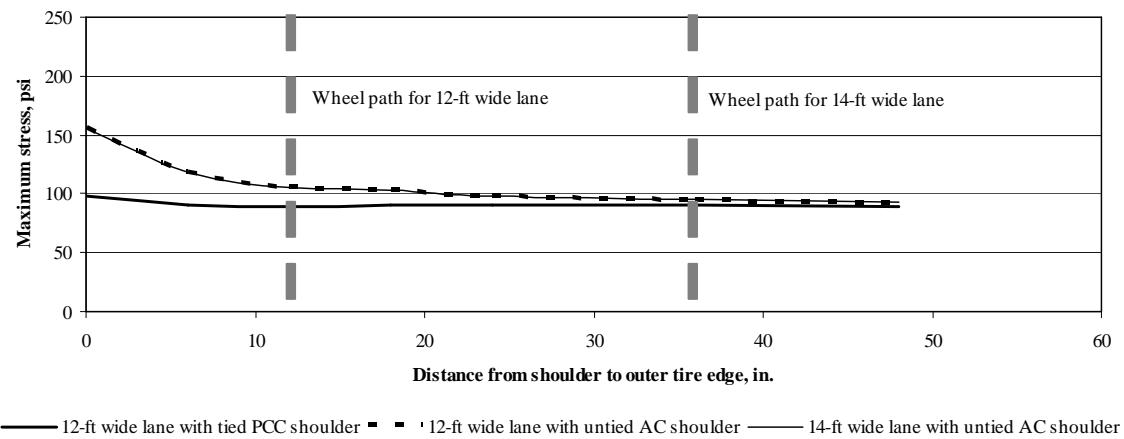
Figures G-4 through G-6 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $0 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-4: Illustration for single axle**

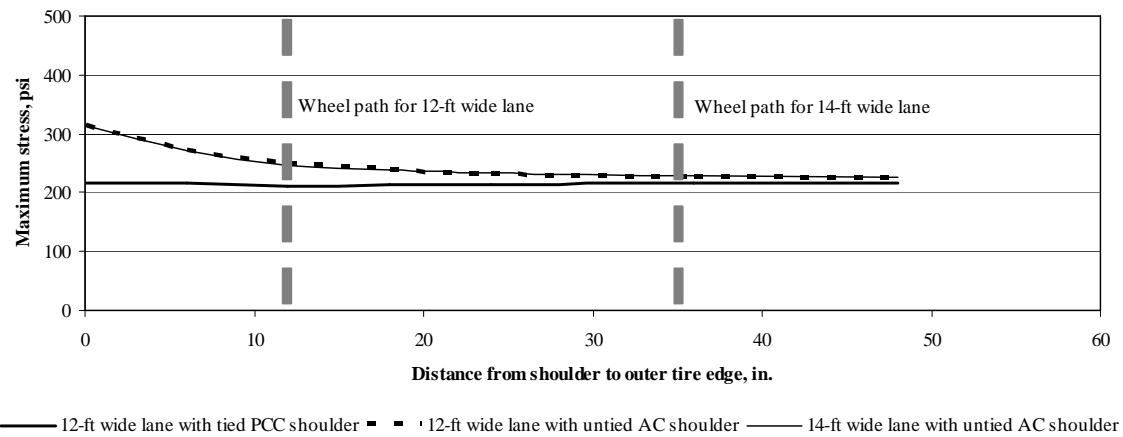


**Figure G-5: Illustration for tandem axle**

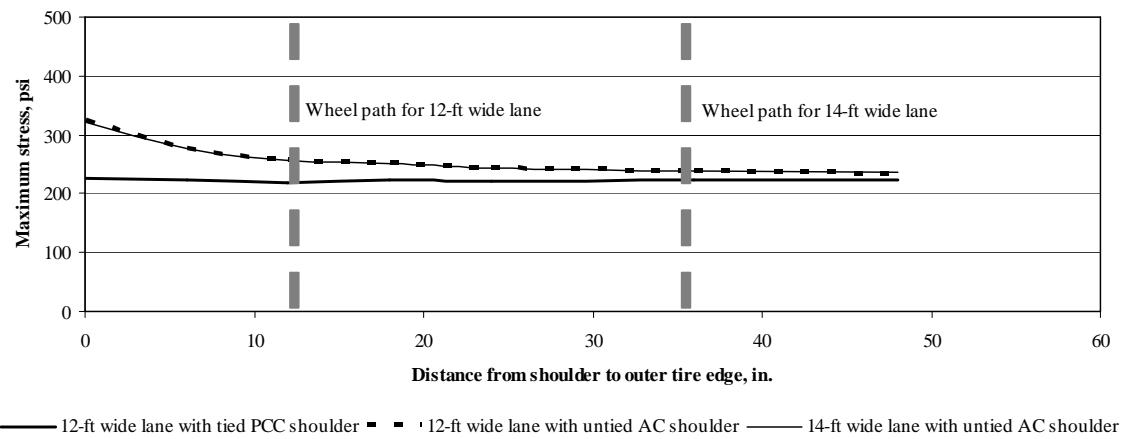


**Figure G-6: Illustration for tridem axle**

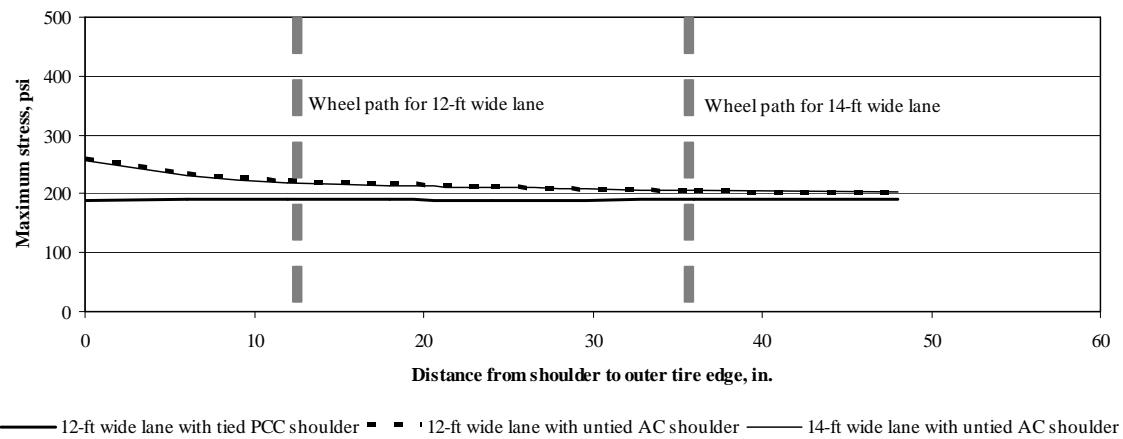
Figures G-7 through G-9 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $10 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-7: Illustration for single axle**

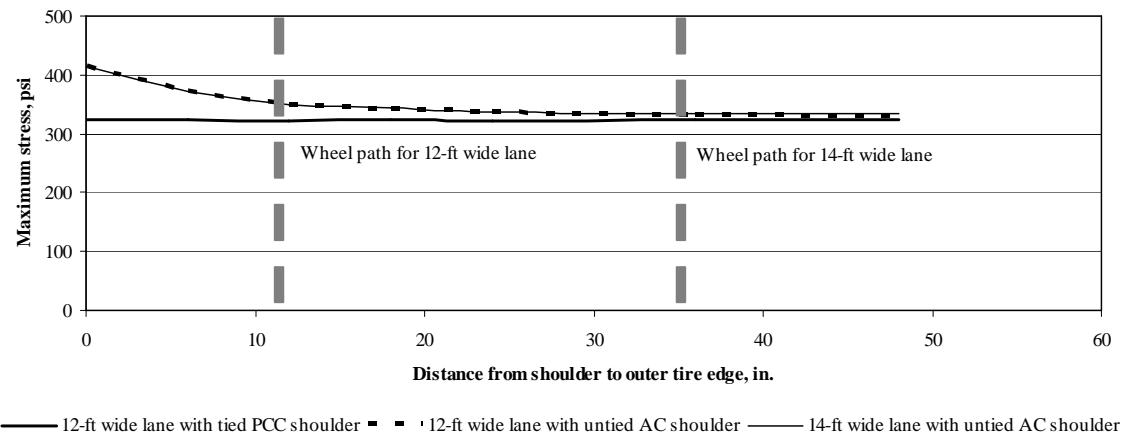


**Figure G-8: Illustration for tandem axle**

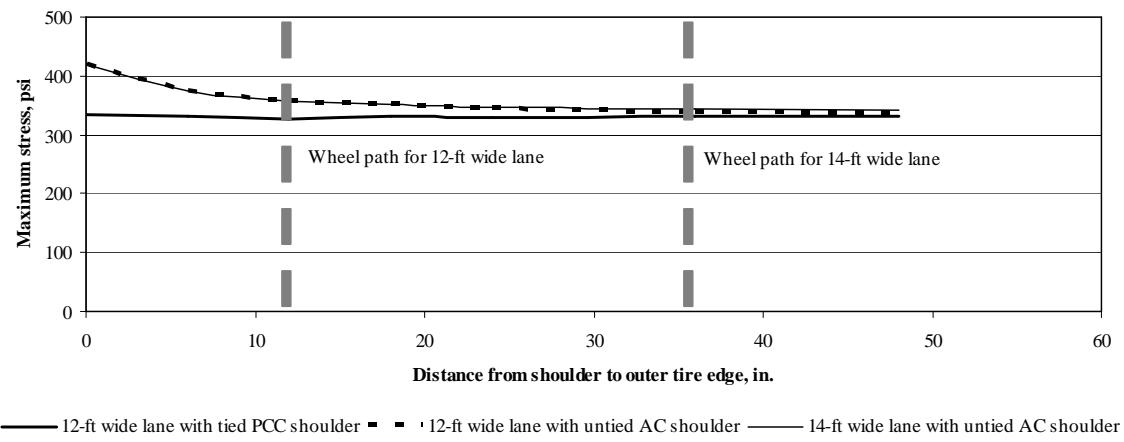


**Figure G-9: Illustration for tridem axle**

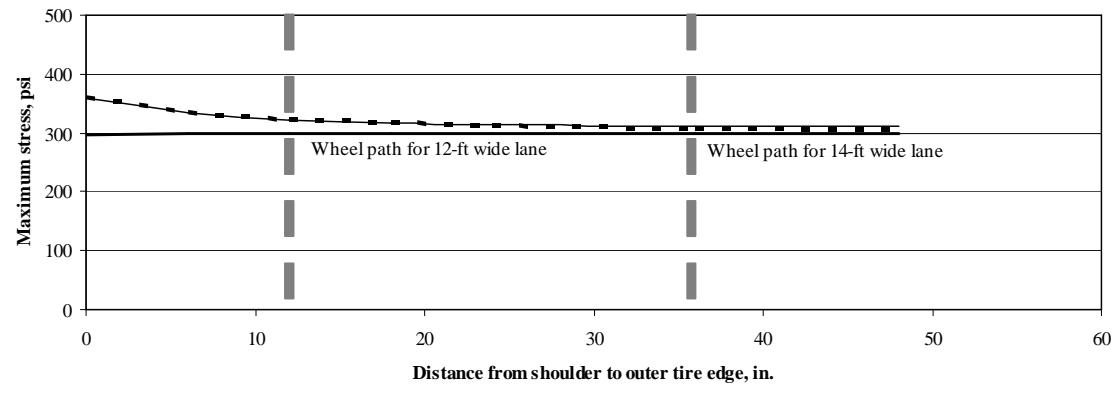
Figures G-10 through G-12 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $10 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-10: Illustration for single axle**

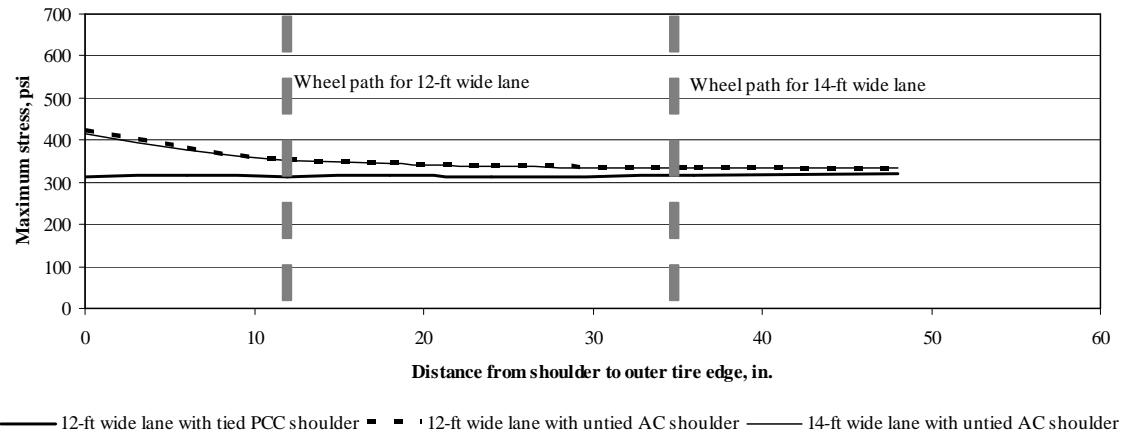


**Figure G-11: Illustration for tandem axle**

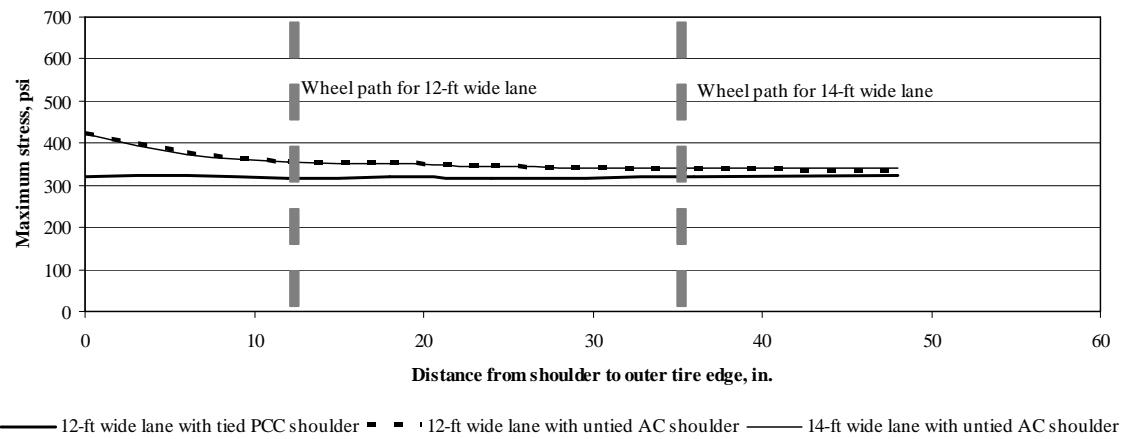


**Figure G-12: Illustration for tridem axle**

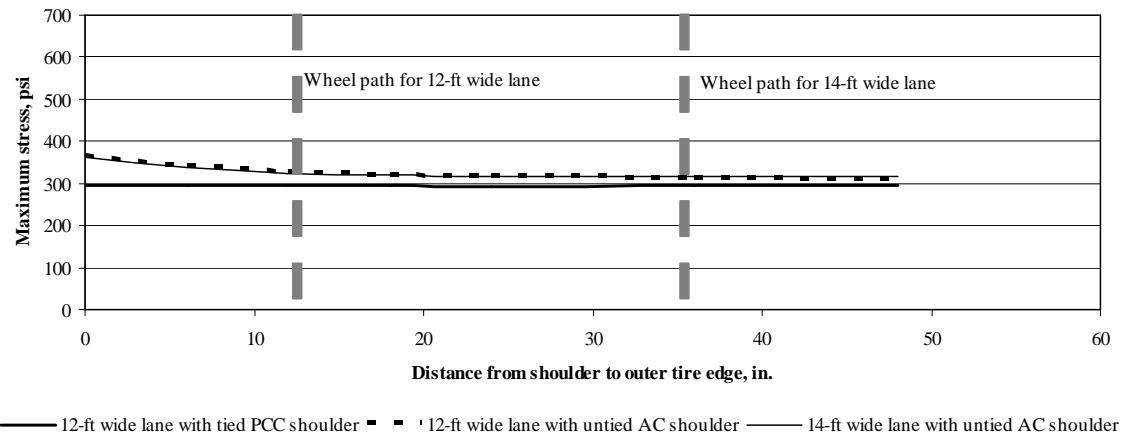
Figures G-13 through G-15 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $20 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-13: Illustration for single axle**

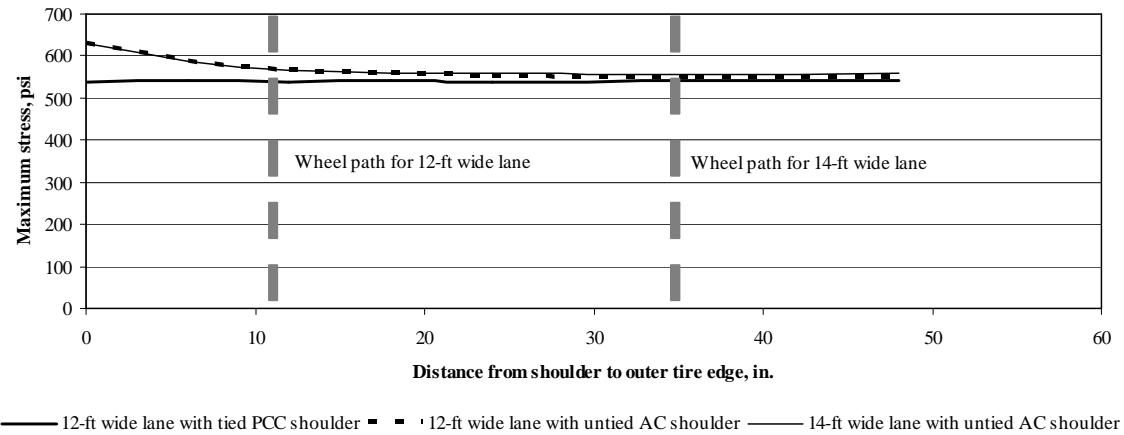


**Figure G-14: Illustration for tandem axle**

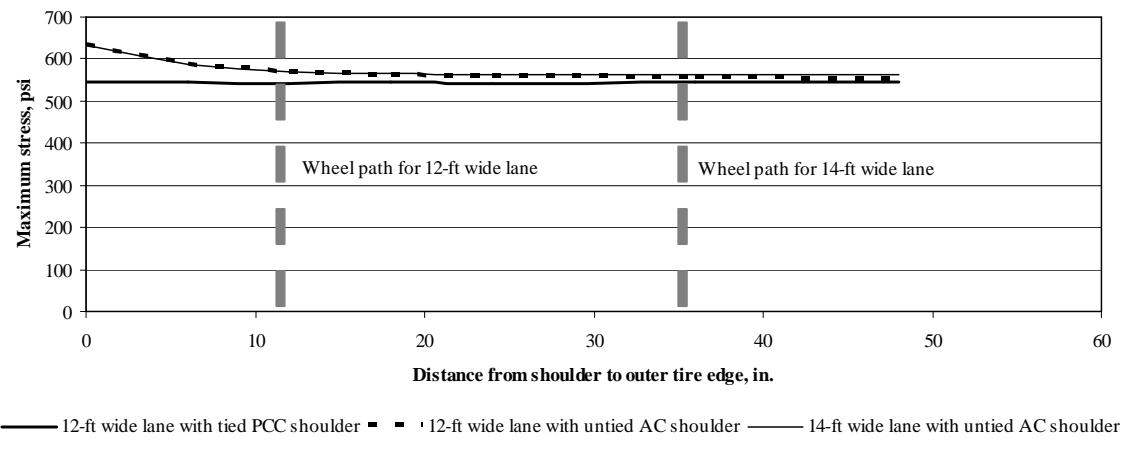


**Figure G-15: Illustration for tridem axle**

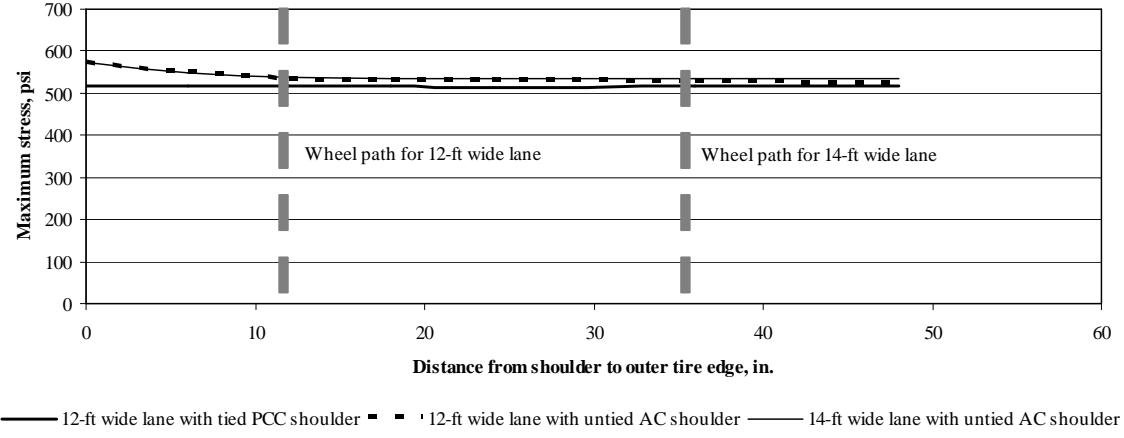
Figures G-16 through G-18 are illustrations of relationship between lateral placement and maximum longitudinal stress at the bottom of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $20 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-16: Illustration for single axle**

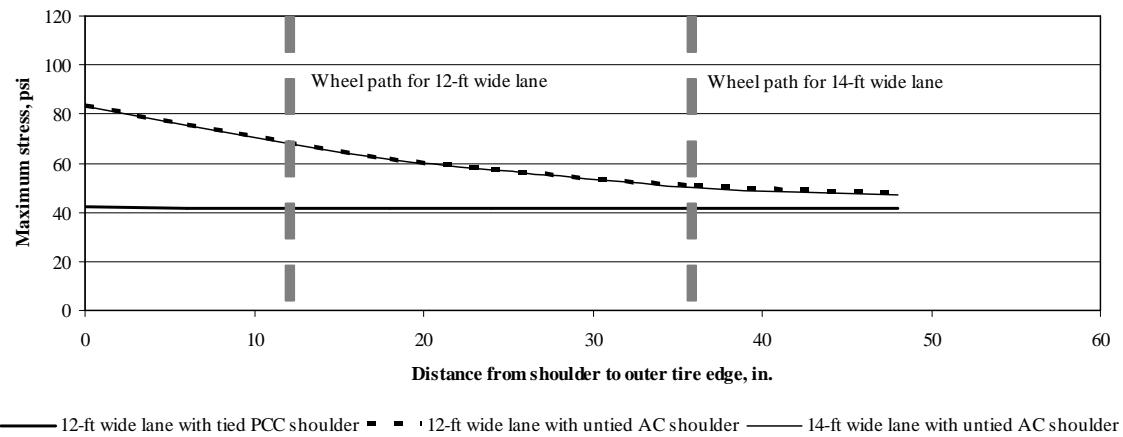


**Figure G-17: Illustration for tandem axle**

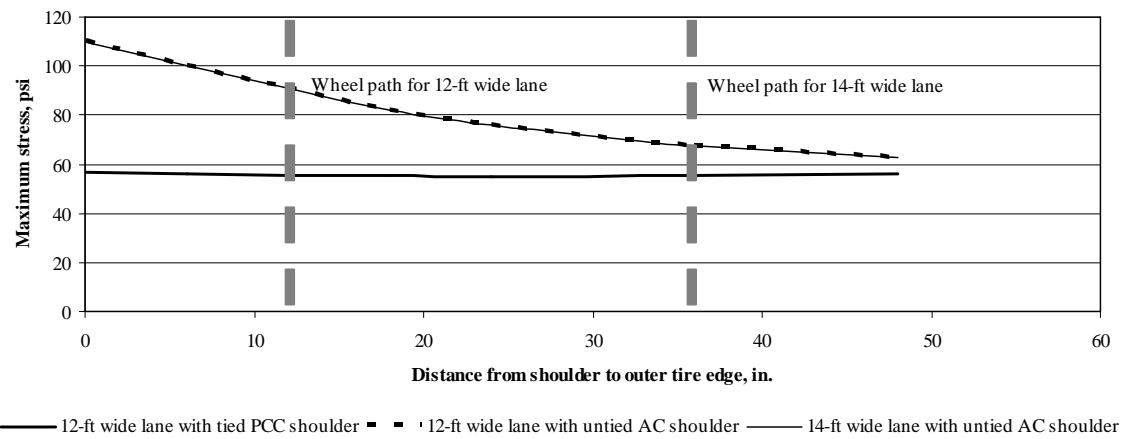


**Figure G-18: Illustration for tridem axle**

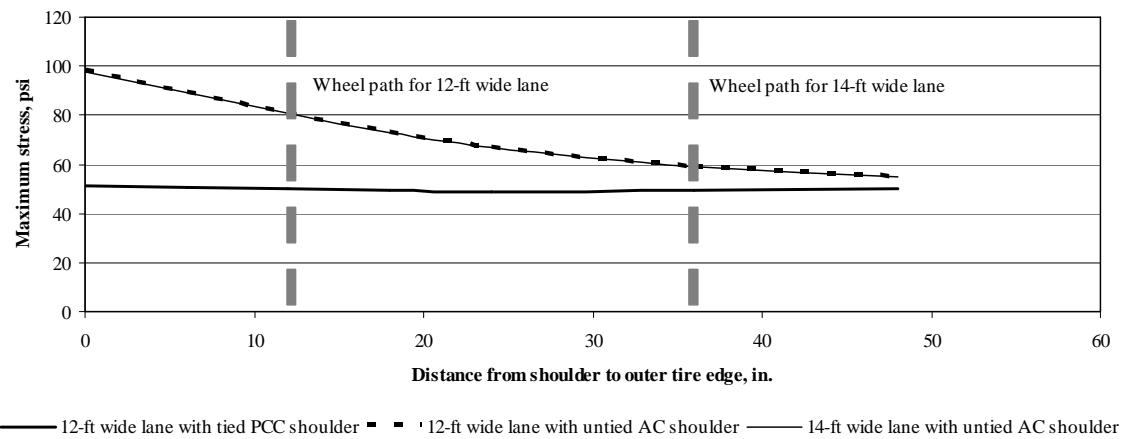
Figures G-19 through G-21 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $0 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-19: Illustration for single axle**

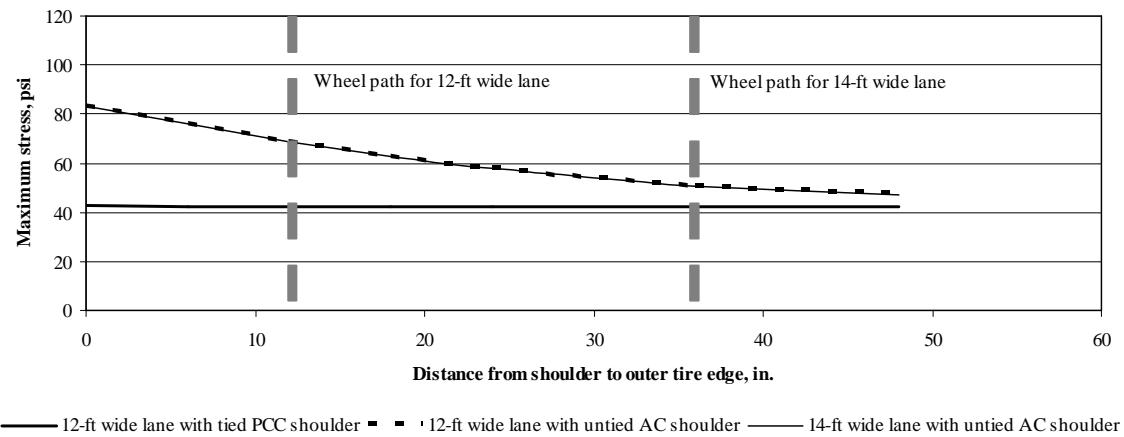


**Figure G-20: Illustration for tandem axle**

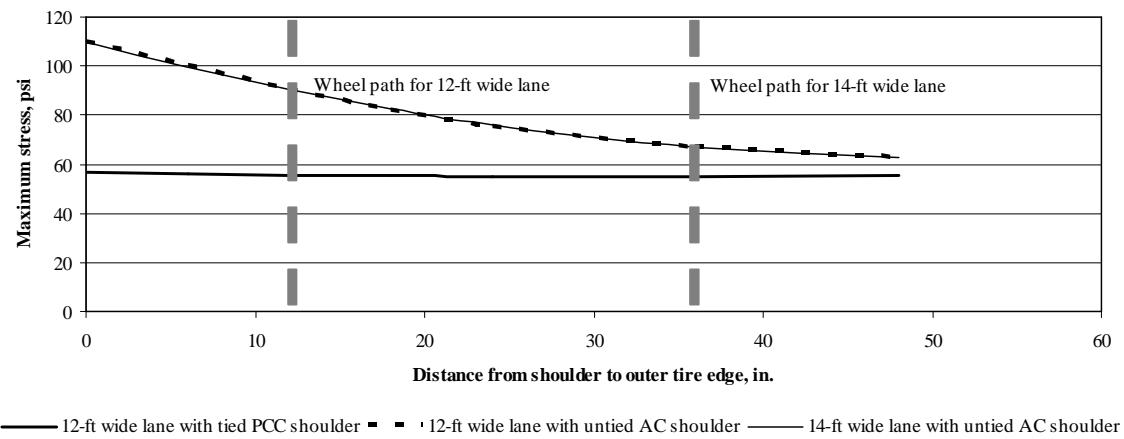


**Figure G-21: Illustration for tridem axle**

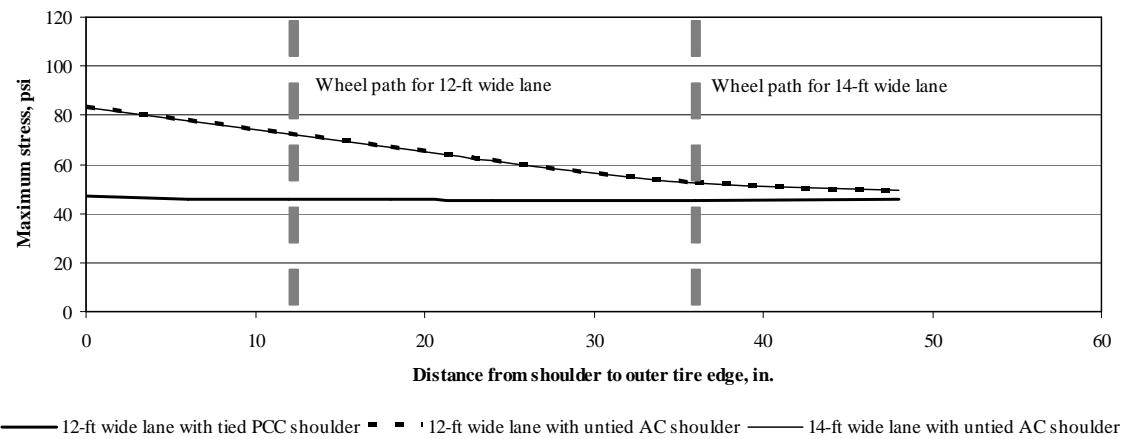
Figures G-22 through G-24 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $0 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-22: Illustration for single axle**

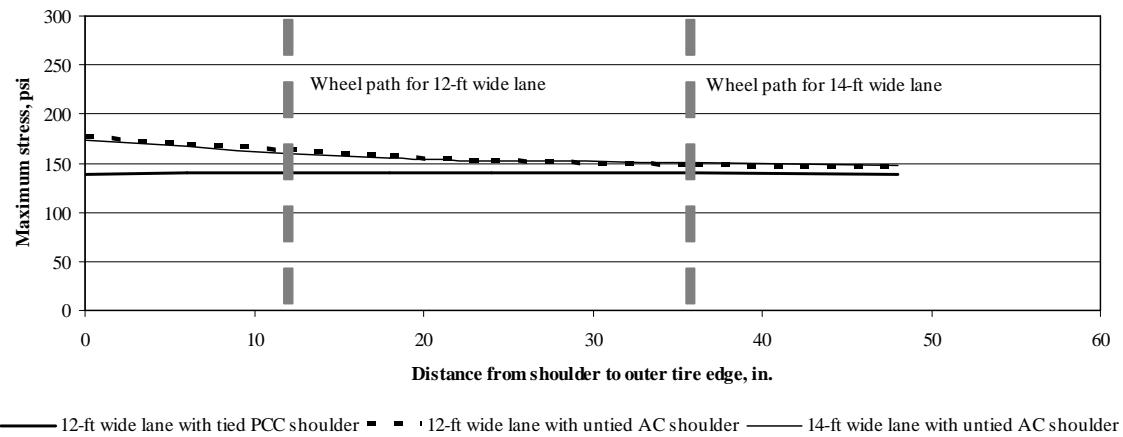


**Figure G-23: Illustration for tandem axle**

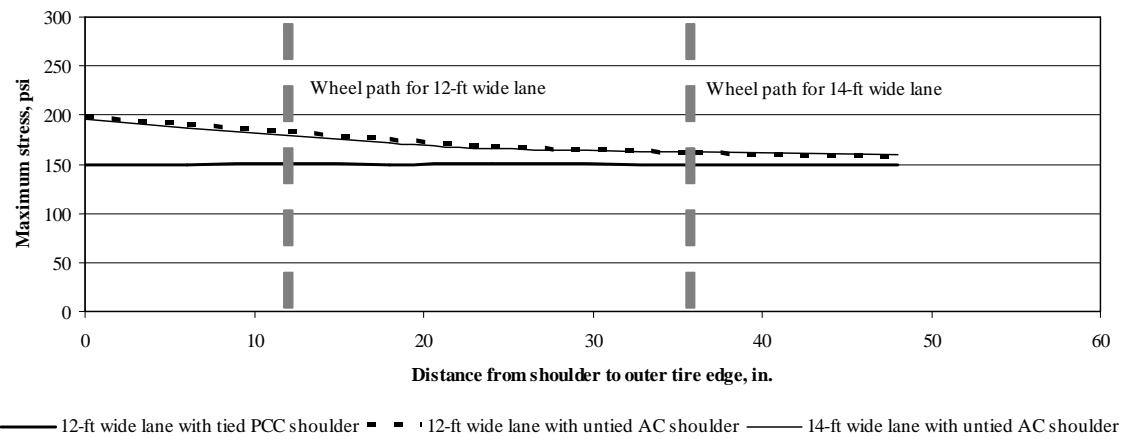


**Figure G-24: Illustration for tridem axle**

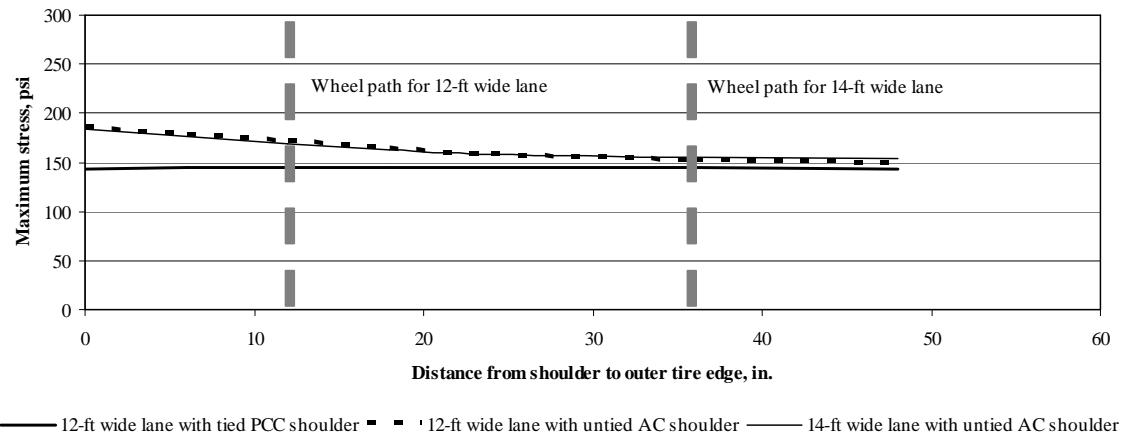
Figures G-25 through G-27 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $-10 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-25: Illustration for single axle**

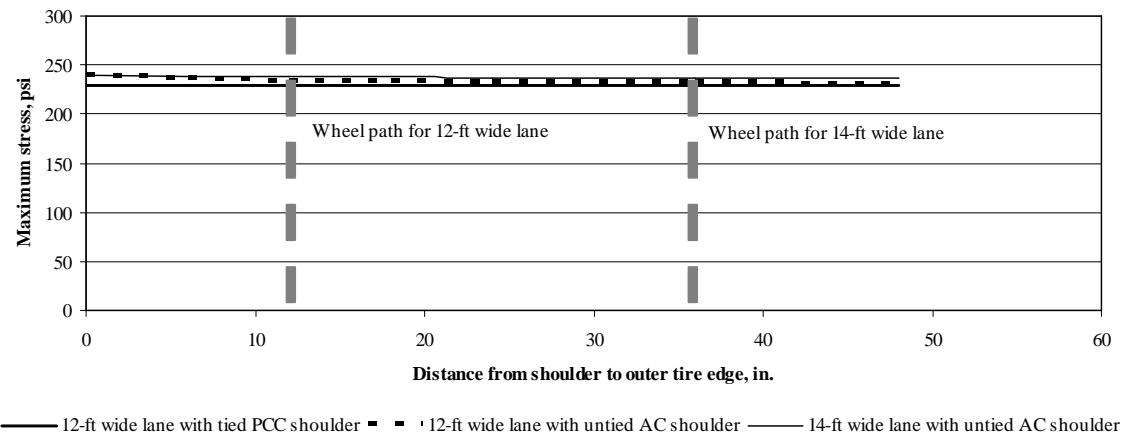


**Figure G-26: Illustration for tandem axle**

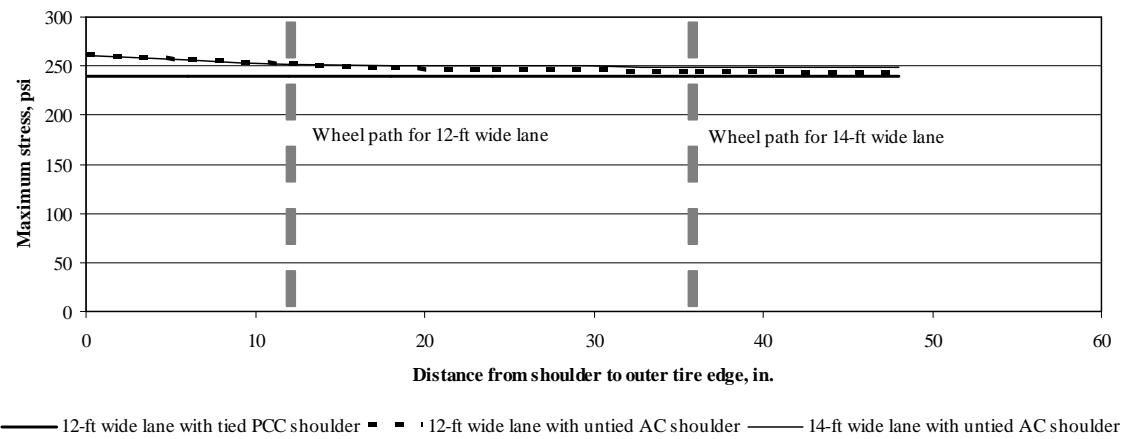


**Figure G-27: Illustration for tridem axle**

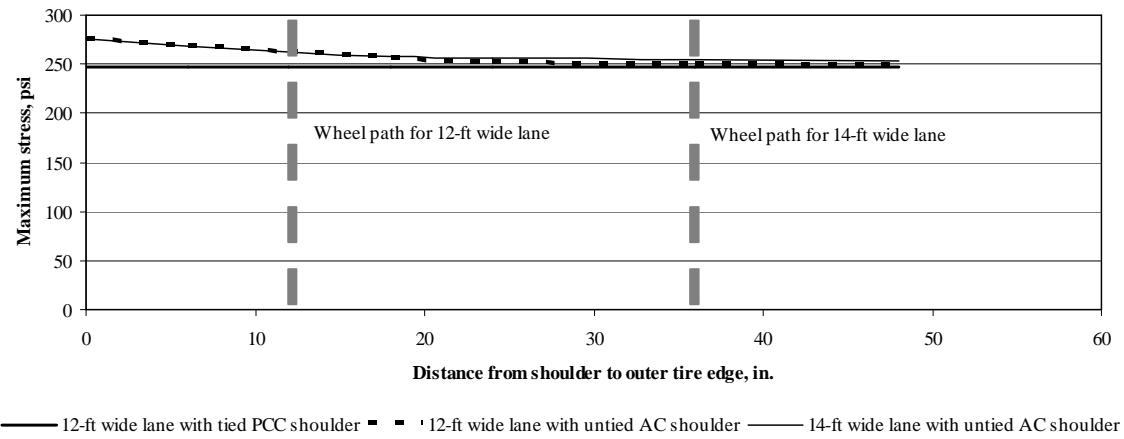
Figures G-28 through G-30 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $-10 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-28: Illustration for single axle**

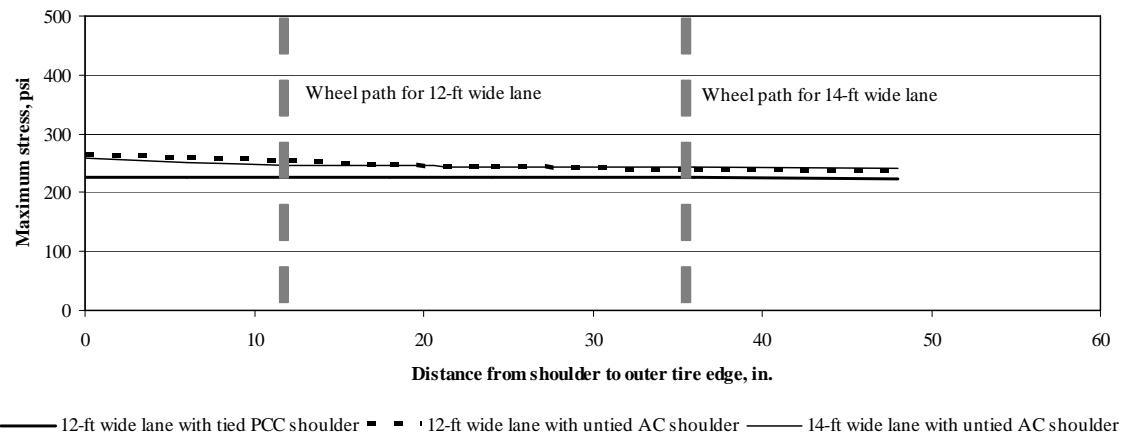


**Figure G-29: Illustration for tandem axle**

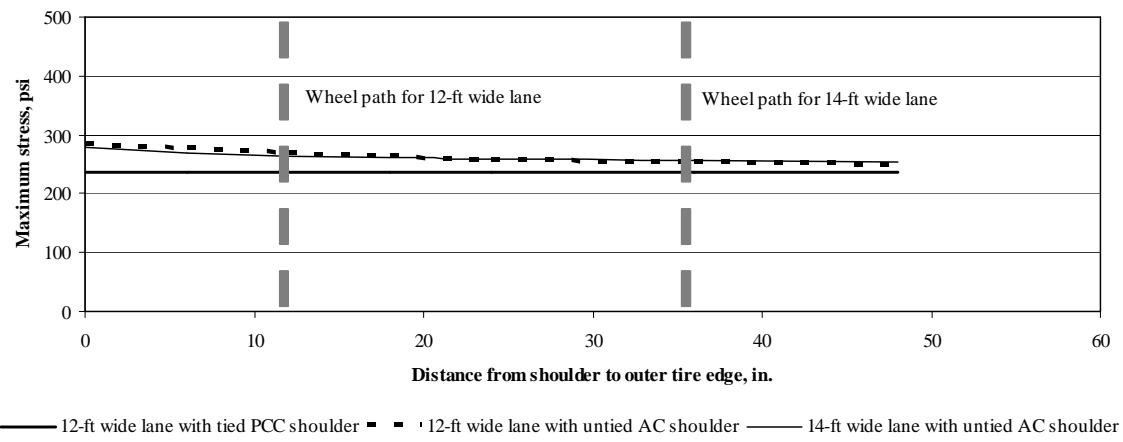


**Figure G-30: Illustration for tridem axle**

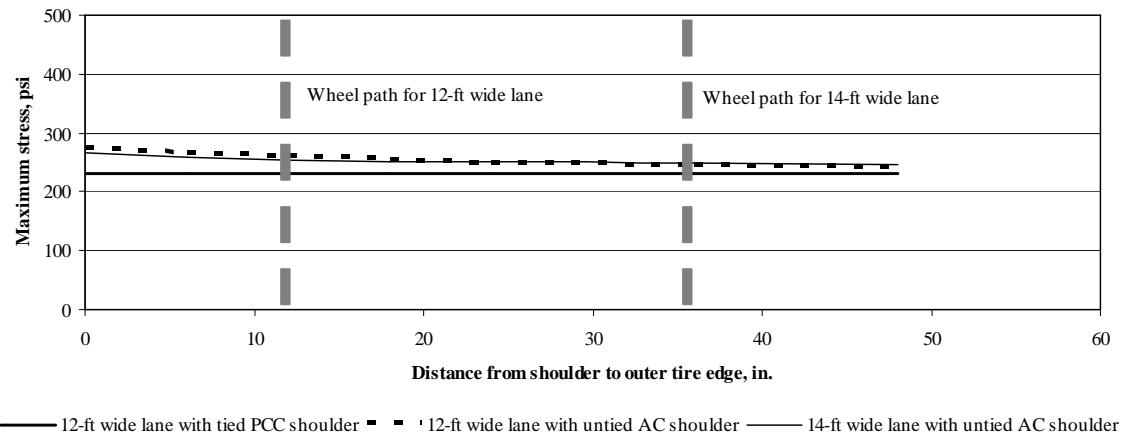
Figures G-31 through G-33 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 177-in. joint spacing and  $\alpha(\Delta T/D)$  of  $-20 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-31: Illustration for single axle**

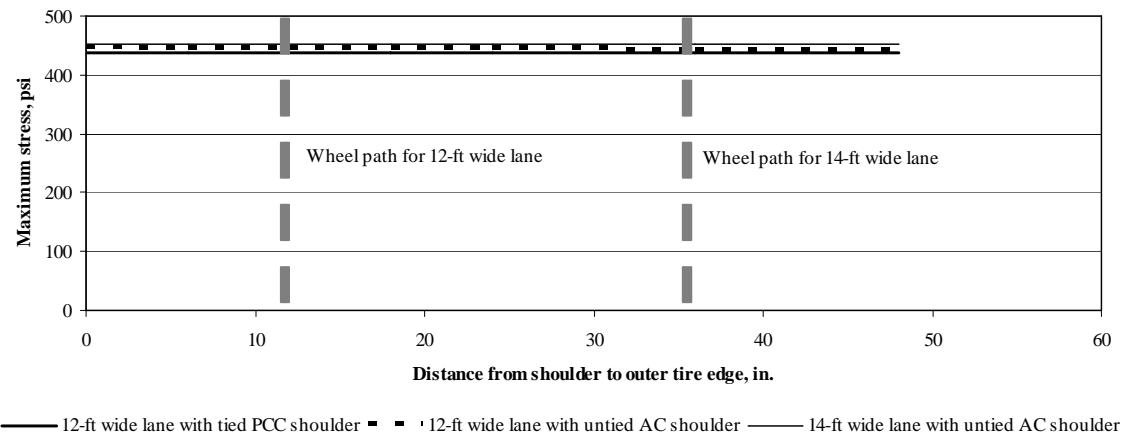


**Figure G-32: Illustration for tandem axle**

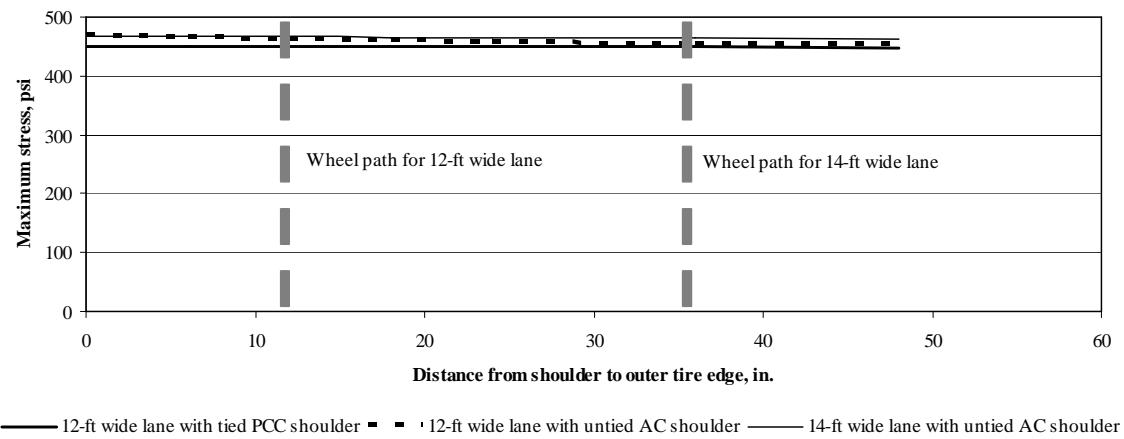


**Figure G-33: Illustration for tridem axle**

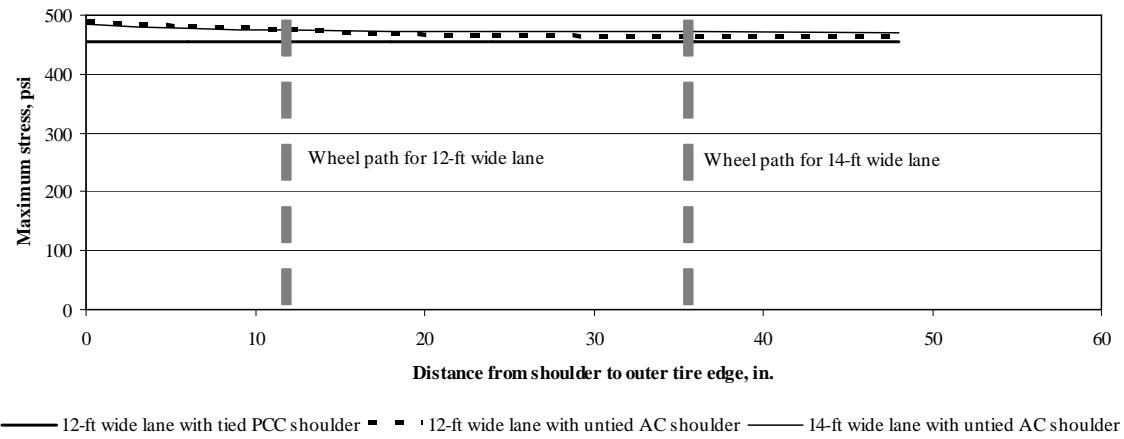
Figures G-34 through G-36 are illustrations of relationship between lateral placement and maximum longitudinal stress at the top of the PCC slab for 315-in. joint spacing and  $\alpha(\Delta T/D)$  of  $-20 \times 10^{-6}$  in.<sup>-1</sup> for various lateral support conditions



**Figure G-34: Illustration for single axle**



**Figure G-35: Illustration for tandem axle**



**Figure G-36: Illustration for tridem axle**

**Table G-2: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and single axle edge loading)**

The regression equation is

$$PCC/AC = 0.860 - 0.0111 Dpcc + 0.000483 k\text{-value} + 0.00439 \text{ AlphaGrad}$$

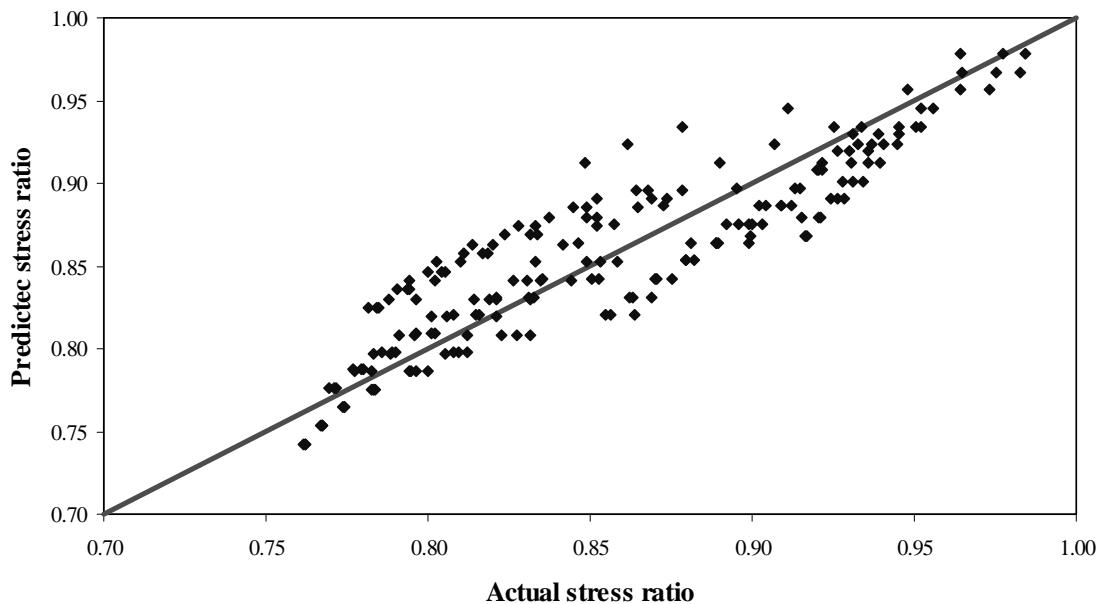
Predictor	Coef	SE Coef	T	P
Constant	0.859752	0.009442	91.06	0.000
Dpcc	-0.0111190	0.0009397	-11.83	0.000
k-value	0.00048316	0.00002694	17.93	0.000
AlphaGra	0.0043865	0.0002302	19.06	0.000

$$S = 0.02584 \quad R-Sq = 81.7\% \quad R-Sq(\text{adj}) = 81.4\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.55063	0.18354	274.92	0.000
Residual Error	185	0.12351	0.00067		
Total	188	0.67414			

Source	DF	Seq SS
Dpcc	1	0.09347
k-value	1	0.21472
AlphaGra	1	0.24244



**Figure G-37: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and single axle)**

**Table G-3: Regression analysis for stress ratio widened lane to AC shoulder  
(177-in. joint spacing and single axle edge loading)**

The regression equation is

Widened Lane/AC = 0.880 - 0.00761 Dpcc + 0.000339 k-value + 0.00444 AlphaGrad

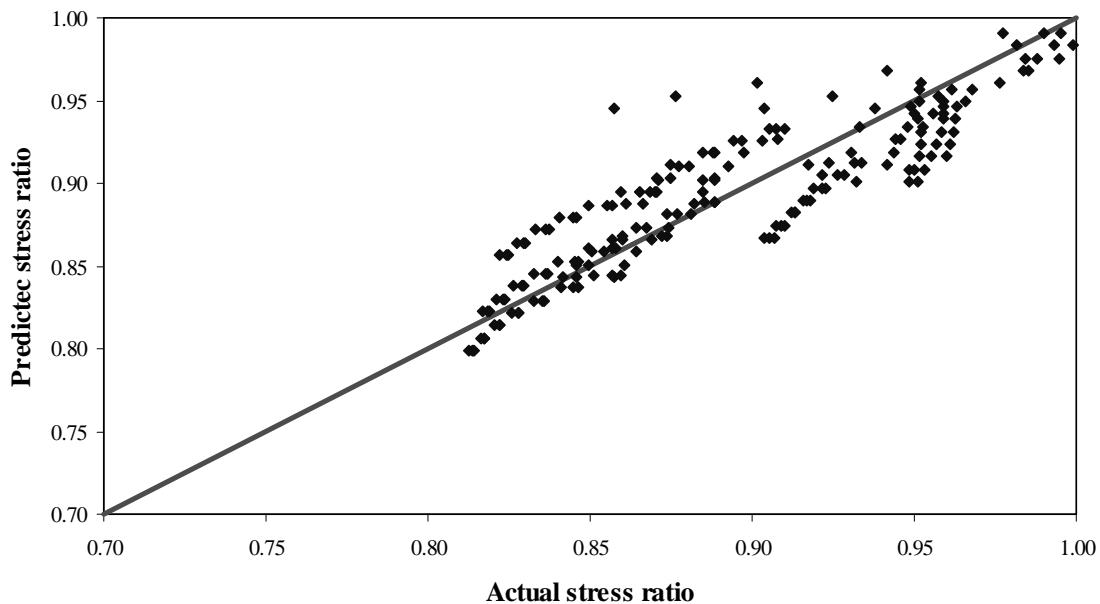
Predictor	Coef	SE Coef	T	P
Constant	0.879577	0.008856	99.32	0.000
Dpcc	-0.0076058	0.0008815	-8.63	0.000
k-value	0.00033932	0.00002527	13.43	0.000
AlphaGra	0.00444429	0.0002159	20.58	0.000

S = 0.02424 R-Sq = 78.6% R-Sq(adj) = 78.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.39835	0.13278	226.06	0.000
Residual Error	185	0.10867	0.00059		
Total	188	0.50702			

Source	DF	Seq SS
Dpcc	1	0.04373
k-value	1	0.10591
AlphaGra	1	0.24871



**Figure G-38: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(177-in. joint spacing and single axle)**

**Table G-4: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and single axle edge loading)**

The regression equation is

$$PCC/AC = 0.827 - 0.00514 Dpcc + 0.000367 k\text{-value} + 0.00691 \text{ AlphaGrad}$$

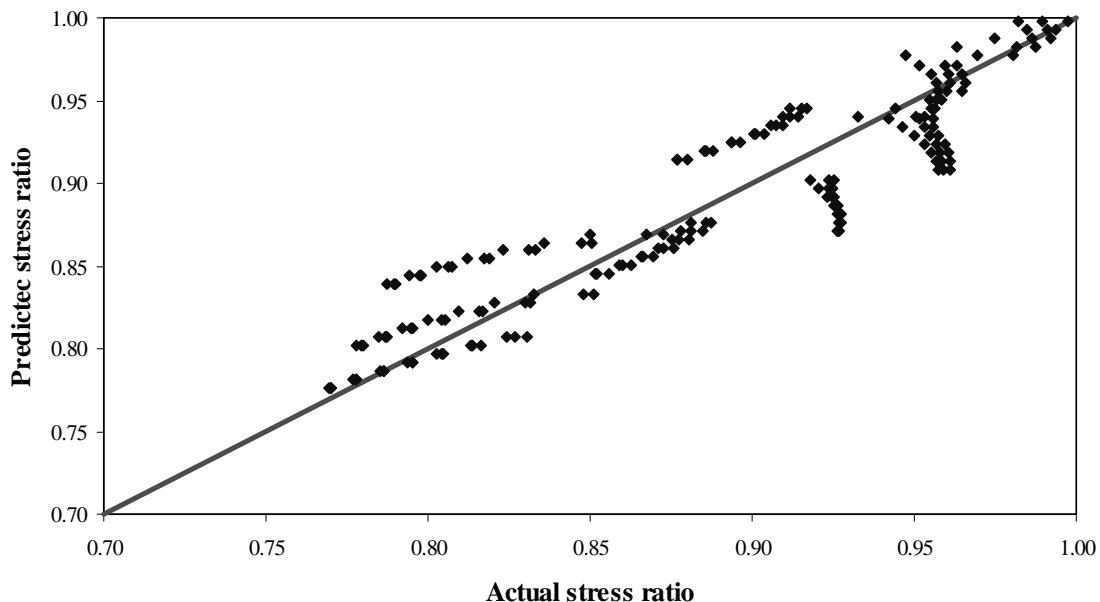
Predictor	Coef	SE Coef	T	P
Constant	0.827158	0.009493	87.13	0.000
Dpcc	-0.0051362	0.0009449	-5.44	0.000
k-value	0.00036729	0.00002709	13.56	0.000
AlphaGra	0.0069079	0.0002314	29.85	0.000

$$S = 0.02598 \quad R-Sq = 85.7\% \quad R-Sq(\text{adj}) = 85.4\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.74529	0.24843	368.08	0.000
Residual Error	185	0.12486	0.00067		
Total	188	0.87015			

Source	DF	Seq SS
Dpcc	1	0.01994
k-value	1	0.12408
AlphaGra	1	0.60127



**Figure G-39: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and single axle)**

**Table G-5: Regression analysis for stress ratio widened lane to AC shoulder  
(315-in. joint spacing and single axle edge loading)**

The regression equation is

Widened Lane/AC = 0.848 - 0.00252 Dpcc + 0.000256 k-value + 0.00650 AlphaGrad

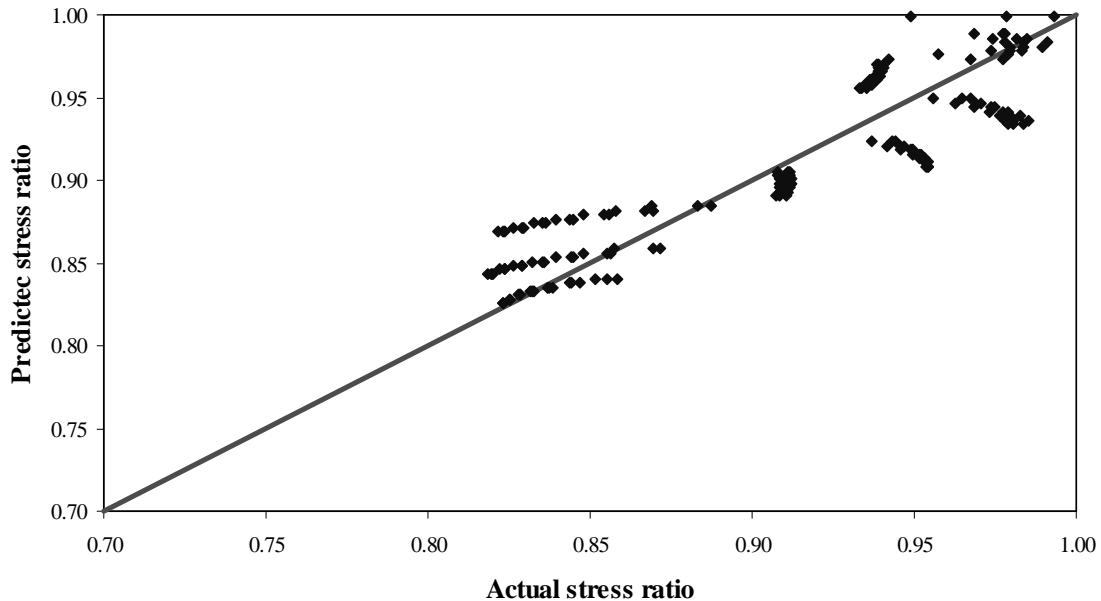
Predictor	Coef	SE Coef	T	P
Constant	0.847724	0.008801	96.32	0.000
Dpcc	-0.0025212	0.0008760	-2.88	0.004
k-value	0.00025563	0.00002511	10.18	0.000
AlphaGra	0.0064984	0.0002146	30.29	0.000

S = 0.02409 R-Sq = 84.8% R-Sq(adj) = 84.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.59700	0.19900	343.03	0.000
Residual Error	185	0.10732	0.00058		
Total	188	0.70432			

Source	DF	Seq SS
Dpcc	1	0.00481
k-value	1	0.06011
AlphaGra	1	0.53209



**Figure G-40: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(315-in. joint spacing and single axle)**

**Table G-6: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and tandem axle edge loading)**

The regression equation is

$$PCC/AC = 0.915 - 0.0149 Dpcc + 0.000563 k\text{-value} + 0.00354 \text{ AlphaGrad}$$

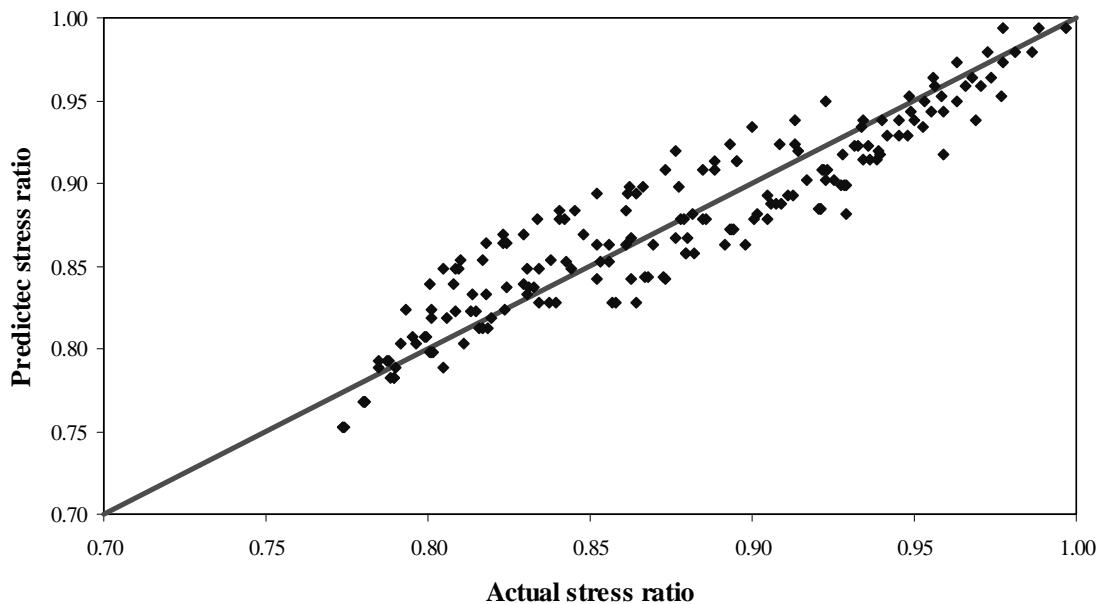
Predictor	Coef	SE Coef	T	P
Constant	0.915068	0.008003	114.34	0.000
Dpcc	-0.0149193	0.0007965	-18.73	0.000
k-value	0.00056274	0.00002284	24.64	0.000
AlphaGra	0.0035389	0.0001951	18.14	0.000

$$S = 0.02190 \quad R-Sq = 87.4\% \quad R-Sq(\text{adj}) = 87.2\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.61735	0.20578	429.03	0.000
Residual Error	185	0.08874	0.00048		
Total	188	0.70609			

Source	DF	Seq SS
Dpcc	1	0.16827
k-value	1	0.29128
AlphaGra	1	0.15780



**Figure G-41: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and tandem axle)**

**Table G-7: Regression analysis for stress ratio widened lane to AC shoulder  
(177-in. joint spacing and tandem axle edge loading)**

The regression equation is

$$\text{Widened Lane/AC} = 0.922 - 0.00989 \text{ Dpcc} + 0.000422 \text{ k-value} + 0.00363 \text{ AlphaGrad}$$

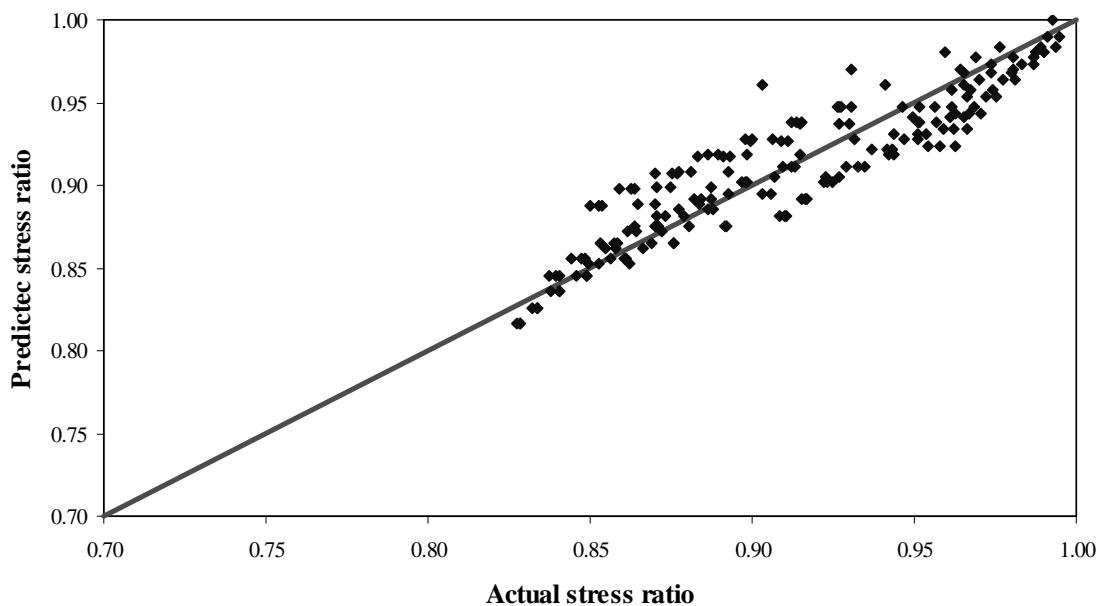
Predictor	Coef	SE Coef	T	P
Constant	0.921743	0.006767	136.21	0.000
Dpcc	-0.0098915	0.0006735	-14.69	0.000
k-value	0.00042194	0.00001931	21.85	0.000
AlphaGra	0.0036286	0.0001650	21.99	0.000

$$S = 0.01852 \quad R-\text{Sq} = 86.4\% \quad R-\text{Sq}(\text{adj}) = 86.2\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.40362	0.13454	392.29	0.000
Residual Error	185	0.06345	0.00034		
Total	188	0.46707			

Source	DF	Seq SS
Dpcc	1	0.07397
k-value	1	0.16375
AlphaGra	1	0.16590



**Figure G-42: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(177-in. joint spacing and tandem axle)**

**Table G-8: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and tandem axle edge loading)**

The regression equation is

$$PCC/AC = 0.889 - 0.00915 Dpcc + 0.000427 k\text{-value} + 0.00547 \text{ AlphaGrad}$$

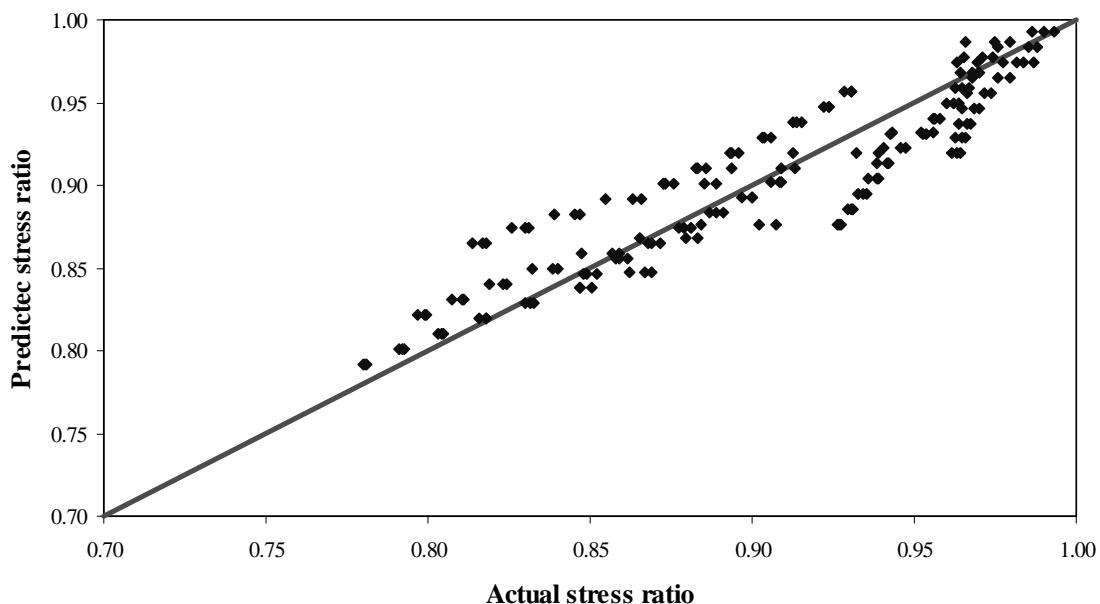
Predictor	Coef	SE Coef	T	P
Constant	0.888734	0.008344	106.52	0.000
Dpcc	-0.0091548	0.0008304	-11.02	0.000
k-value	0.00042660	0.00002381	17.92	0.000
AlphaGra	0.0054675	0.0002034	26.88	0.000

$$S = 0.02283 \quad R-Sq = 86.3\% \quad R-Sq(\text{adj}) = 86.1\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.60741	0.20247	388.35	0.000
Residual Error	185	0.09645	0.00052		
Total	188	0.70386			

Source	DF	Seq SS
Dpcc	1	0.06336
k-value	1	0.16739
AlphaGra	1	0.37665



**Figure G-43: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and tandem axle)**

**Table G-9: Regression analysis for stress ratio widened lane to AC shoulder  
(315-in. joint spacing and tandem axle edge loading)**

The regression equation is

$$\text{Widened Lane/AC} = 0.905 - 0.00581 \text{ Dpcc} + 0.000308 \text{ k-value} + 0.00506 \text{ AlphaGrad}$$

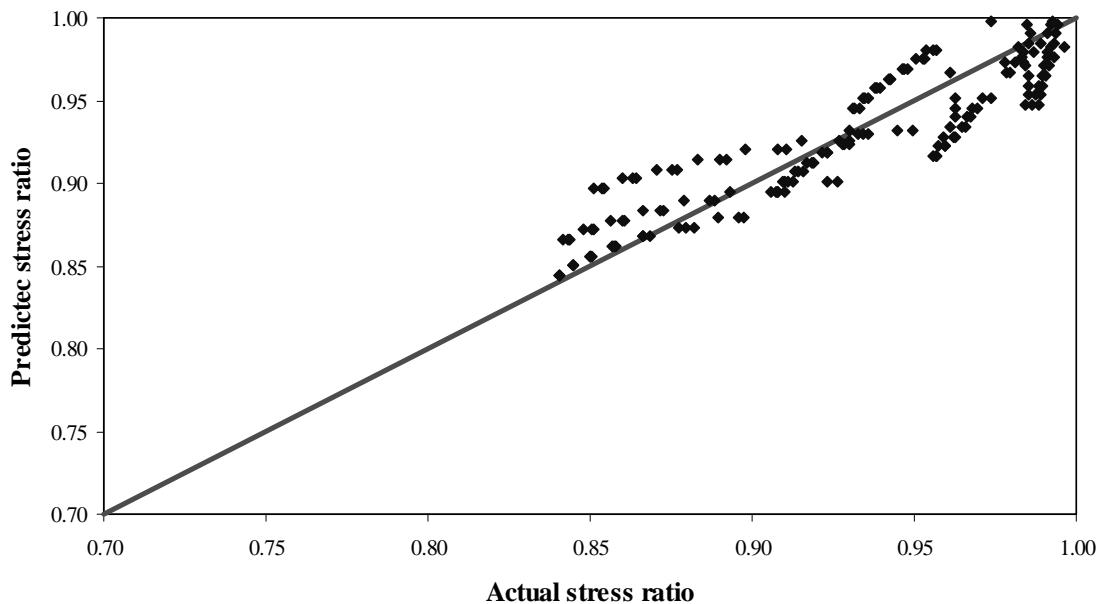
Predictor	Coef	SE Coef	T	P
Constant	0.905088	0.007328	123.51	0.000
Dpcc	-0.0058122	0.0007293	-7.97	0.000
k-value	0.00030774	0.00002091	14.72	0.000
AlphaGra	0.0050603	0.0001787	28.32	0.000

$$S = 0.02005 \quad R-\text{Sq} = 85.4\% \quad R-\text{Sq}(\text{adj}) = 85.2\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.43529	0.14510	360.80	0.000
Residual Error	185	0.07440	0.00040		
Total	188	0.50969			

Source	DF	Seq SS
Dpcc	1	0.02554
k-value	1	0.08711
AlphaGra	1	0.32265



**Figure G-44: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(315-in. joint spacing and tandem axle edge loading)**

**Table G-10: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and tridem axle edge loading)**

The regression equation is

$$PCC/AC = 0.932 - 0.0167646 Dpcc + 0.000696 k\text{-value} + 0.00304 \text{ AlphaGrad}$$

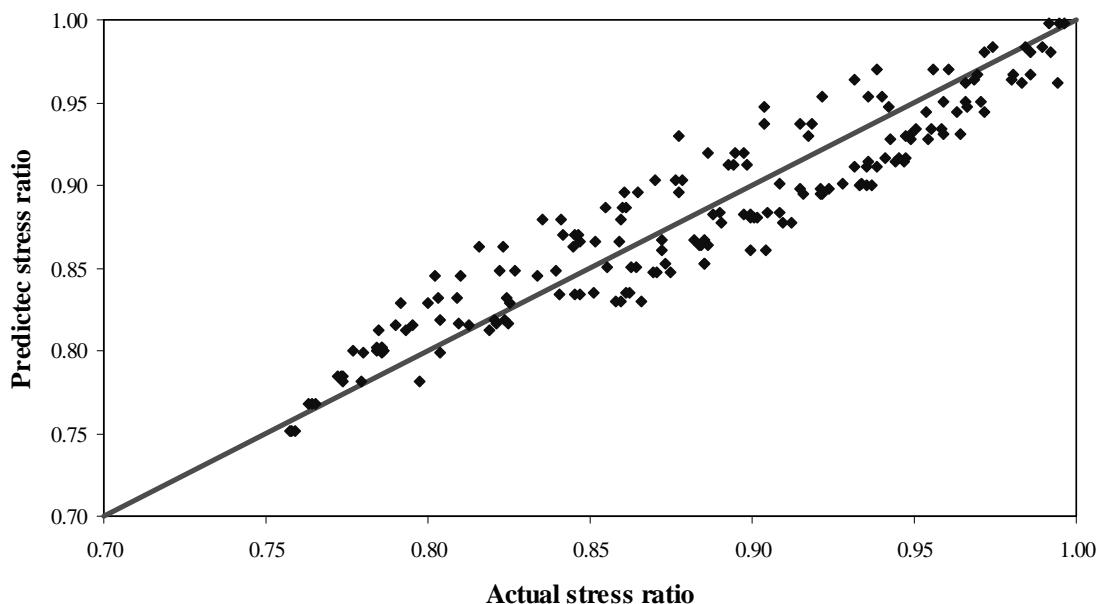
Predictor	Coef	SE Coef	T	P
Constant	0.931984	0.008292	112.40	0.000
Dpcc	-0.0167646	0.0008253	-20.31	0.000
k-value	0.00069601	0.00002366	29.42	0.000
AlphaGra	0.0030373	0.0002022	15.02	0.000

$$S = 0.02269 \quad R-Sq = 89.0\% \quad R-Sq(\text{adj}) = 88.9\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.77429	0.25810	501.24	0.000
Residual Error	185	0.09526	0.00051		
Total	188	0.86955			

Source	DF	Seq SS
Dpcc	1	0.21247
k-value	1	0.44558
AlphaGra	1	0.11624



**Figure G-45: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(177-in. joint spacing and tridem axle)**

**Table G-11: Regression analysis for stress ratio widened to AC shoulder  
(177-in. joint spacing and tridem axle edge loading)**

The regression equation is

$$\text{Widened Lane/AC} = 0.942 - 0.0120 \text{ Dpcc} + 0.000532 \text{ k-value} + 0.00335 \text{ AlphaGrad}$$

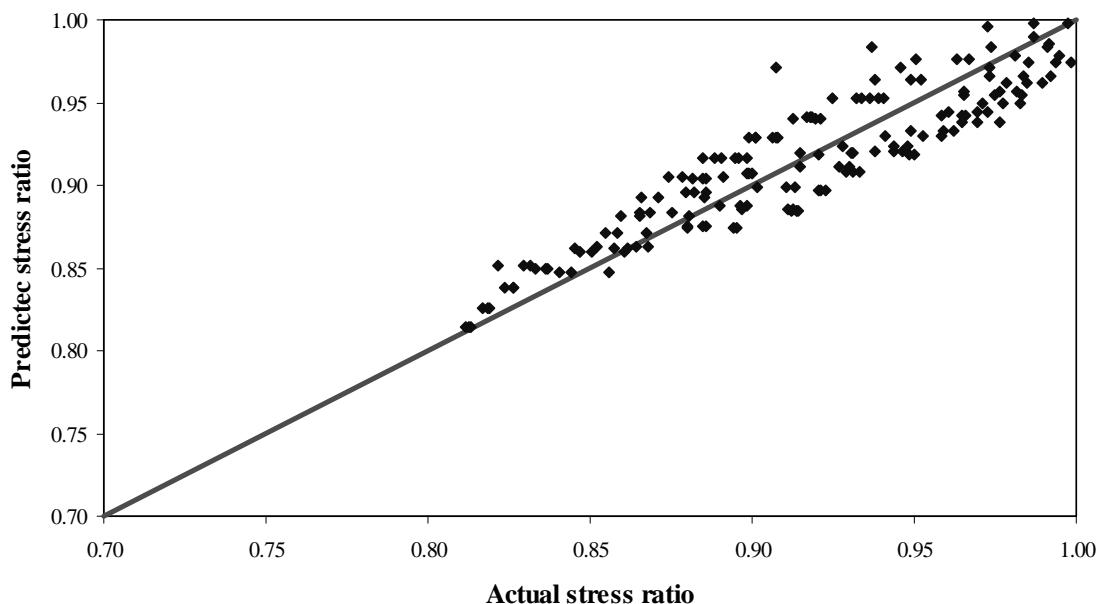
Predictor	Coef	SE Coef	T	P
Constant	0.941706	0.007279	129.38	0.000
Dpcc	-0.0120106	0.0007245	-16.58	0.000
k-value	0.00053182	0.00002077	25.61	0.000
AlphaGra	0.0033476	0.0001775	18.86	0.000

$$S = 0.01992 \quad R-\text{Sq} = 87.4\% \quad R-\text{Sq}(\text{adj}) = 87.2\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.51041	0.17014	428.80	0.000
Residual Error	185	0.07340	0.00040		
Total	188	0.58381			

Source	DF	Seq SS
Dpcc	1	0.10906
k-value	1	0.26015
AlphaGra	1	0.14120



**Figure G-46: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(177-in. joint spacing and tridem axle)**

**Table G-12: Regression analysis for stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and tridem axle edge loading)**

The regression equation is

$$PCC/AC = 0.943 - 0.0132 Dpcc + 0.000560 k\text{-value} + 0.00418 \text{AlphaGrad}$$

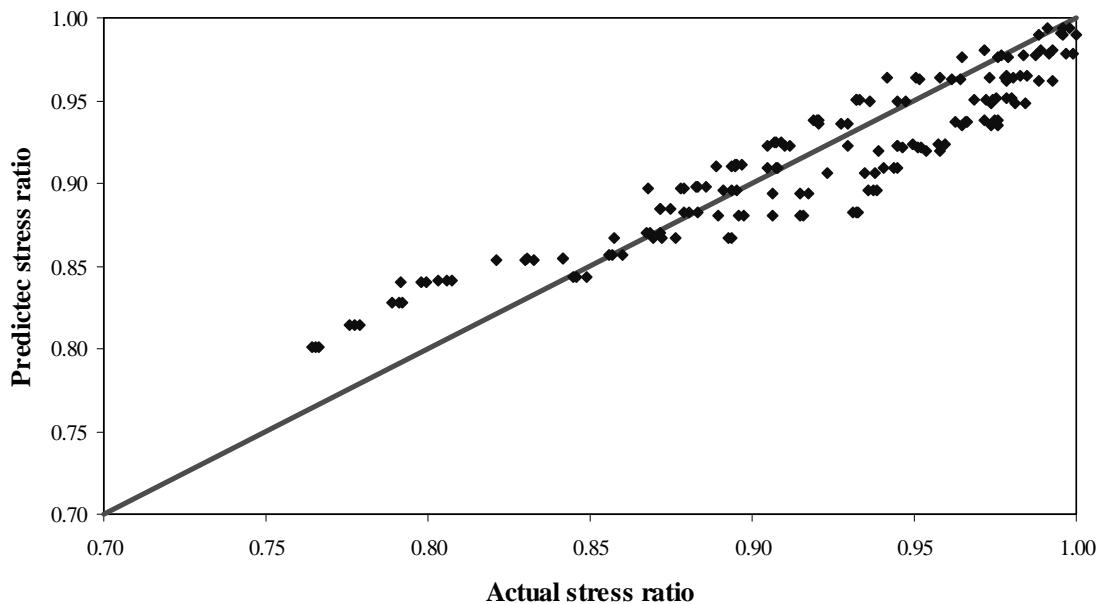
Predictor	Coef	SE Coef	T	P
Constant	0.943019	0.008972	105.11	0.000
Dpcc	-0.0131825	0.0008930	-14.76	0.000
k-value	0.00055957	0.00002560	21.86	0.000
AlphaGra	0.0041833	0.0002187	19.13	0.000

$$S = 0.02455 \quad R-Sq = 85.2\% \quad R-Sq(\text{adj}) = 84.9\%$$

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.63988	0.21329	353.81	0.000
Residual Error	185	0.11153	0.00060		
Total	188	0.75141			

Source	DF	Seq SS
Dpcc	1	0.13138
k-value	1	0.28800
AlphaGra	1	0.22050



**Figure G-47: Comparison between predicted and actual stress ratio PCC shoulder to AC shoulder  
(315-in. joint spacing and tridem axle)**

**Table G-13: Regression analysis for stress ratio widened lane to AC shoulder  
(315-in. joint spacing and tridem axle edge loading)**

The regression equation is

Widened Lane/AC = 0.953 - 0.00909 Dpcc + 0.000407 k-value + 0.00397 AlphaGrad

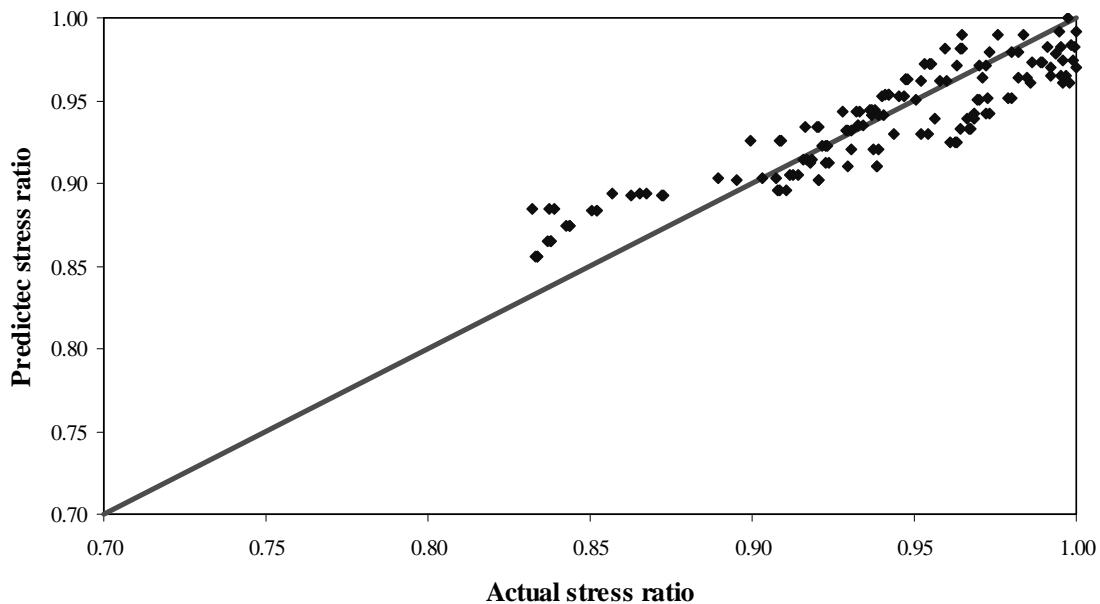
Predictor	Coef	SE Coef	T	P
Constant	0.952682	0.007765	122.69	0.000
Dpcc	-0.0090886	0.0007728	-11.76	0.000
k-value	0.00040699	0.00002216	18.37	0.000
AlphaGra	0.0039659	0.0001893	20.95	0.000

S = 0.02125      R-Sq = 83.2%      R-Sq(adj) = 82.9%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	0.41298	0.13766	304.87	0.000
Residual Error	185	0.08353	0.00045		
Total	188	0.49651			

Source	DF	Seq SS
Dpcc	1	0.06245
k-value	1	0.15236
AlphaGra	1	0.19817



**Figure G-48: Comparison between predicted and actual stress ratio widened lane to AC shoulder  
(315-in. joint spacing and tridem axle)**